

# The Human Excretory System

Oct 27-9:59 AM

## Learning Objectives:

- 1) Describe the main structures of the human urinary system, including the kidney, ureter, bladder, urethra and nephrons.
- 2) Explain the role of the kidney as an excretory organ in removing metabolic wastes from the body and excreting them to the environment, and the impact of kidney failure.

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## The Human Excretory System

- maintains homeostasis by removing metabolic wastes such as water, salt, and metabolite concentration in the blood
- kidneys are the primary excretory organ

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## The Kidney

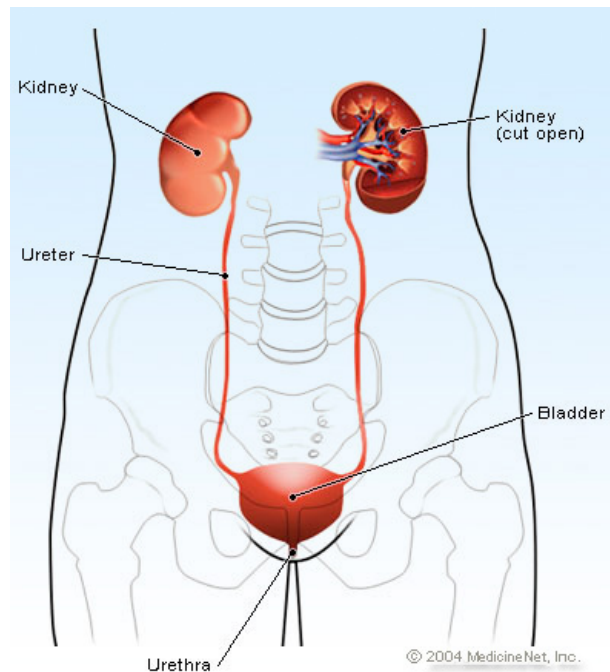
- have two fist sized kidneys located in the lower back on either side of the spine
- release their waste product (urine) into tubes called **ureters**, which carry the fluid to the **bladder**
- the bladder can hold a maximum of 600 ml of fluid; however we become aware after there is 250 ml of urine in the bladder
- drainage is controlled by two rings of muscles called sphincters
  - one involuntarily controlled by the brain
  - second we learn to control as a child

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- Urine exits the bladder through a tube called the urethra

- males = 20 cm long and merges with the vas deferens from the testes to form a single urogenital tract

- females = 4 cm long and the reproductive and urinary tracts have separate openings



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## Kidney Functions

- principle function it to filter the blood in order to remove cellular waste products from the body.
  - at any time 20% of the body's blood is in the kidney

- most people have two kidneys but can function with only one.

- main metabolic wastes are urea, uric acid, and creatinine - potentially damaging to the body

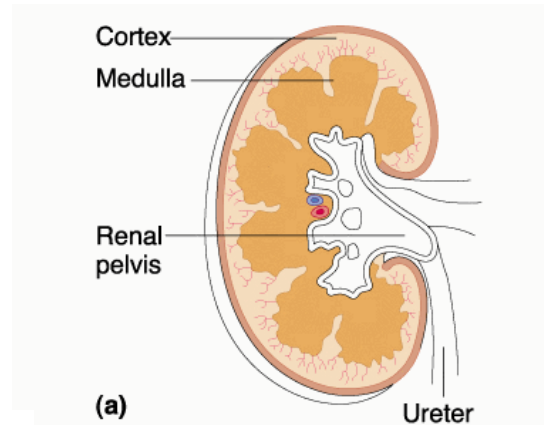
(major component of all waste is N - this is where amino acids are released)

- secretes erythropoietin - hormone that stimulates red blood cell production

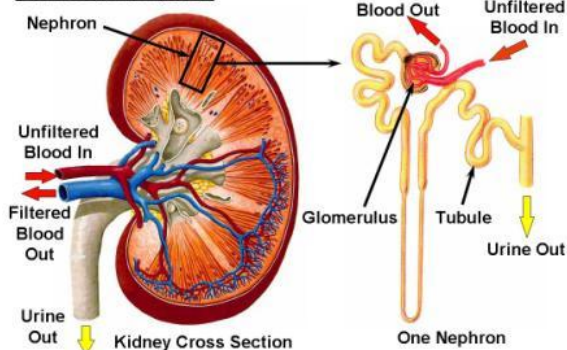
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## Kidney Structure

- has three sections:
  - cortex
  - medulla
  - renal pelvis
- Within the cortex and medulla are about one million tiny filters called **nephrons**



Parts of the Nephron



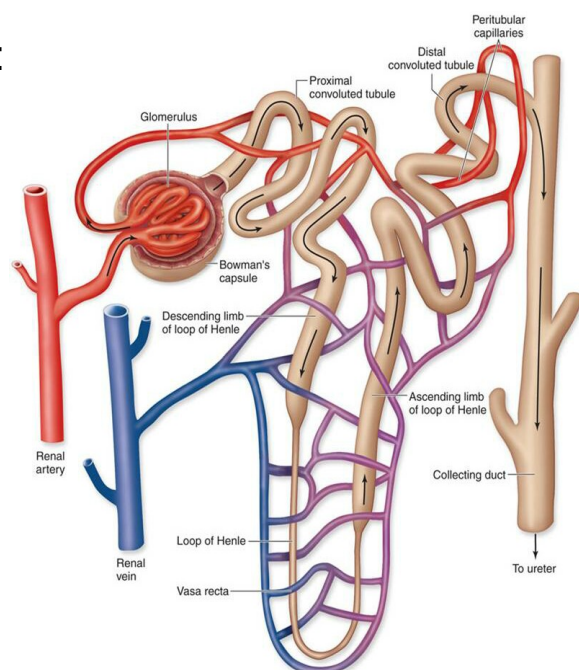
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## The Nephron

Nephrons consists of five parts:

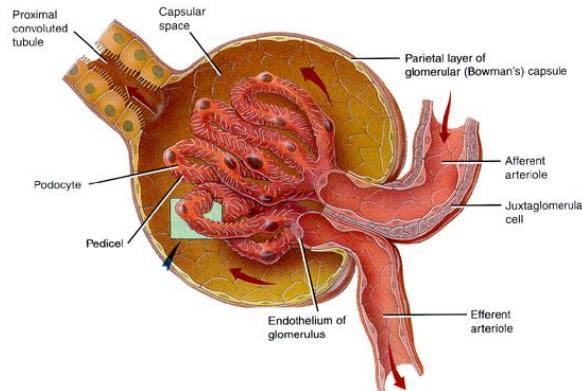
- Bowman's capsule
  - Proximal tubule
  - Loop of Henle
  - Distal tubule
  - Collecting duct
- Upper portion of the nephron are found in the renal cortex while the loop of Henle is located in the medulla.
  - responsible for filtering the blood to maintain homeostasis



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## How the Nephron Works

- Blood enters the Bowman's capsule through a tiny artery that branches into capillaries called the **glomerulus**
- The fluid in the Bowman's capsule is called the **nephric filtrate** and it is pushed out of the capsule into the **proximal tubule**.



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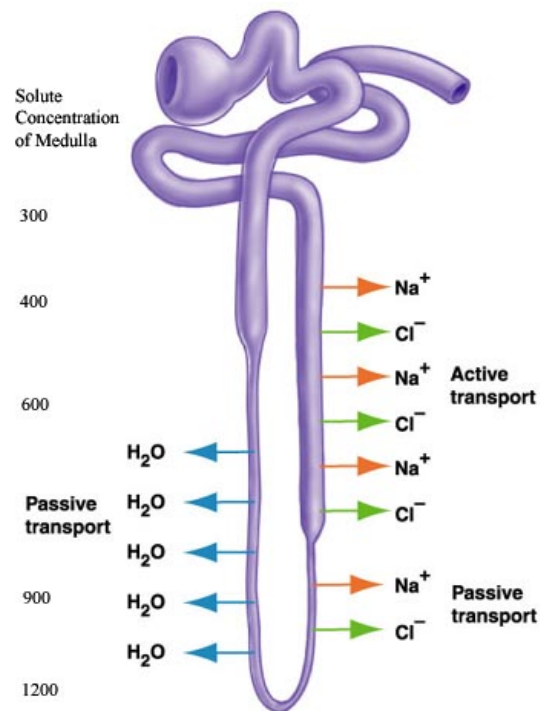
## Proximal Tubule

- filtrate reabsorption occurs - filtrate return to the blood stream - via the process of osmosis, diffusion, and active transport
- glucose, water, amino acids, and ions are removed from the filtrate
- filtrate removal is by the tiny projections found in the proximal tubule
- Fluid at the end of the proximal tubule is isotonic with the surrounding cells just prior to entering the loop of Henle

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## The Loop of Henle

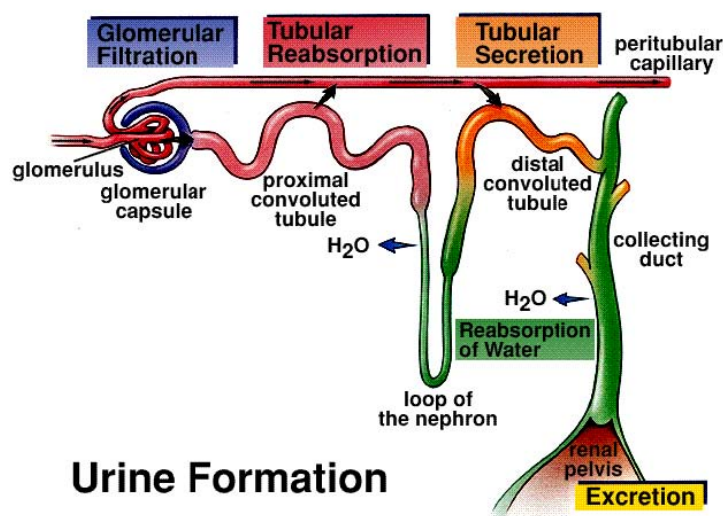
- primary function is to remove water from the filtrate through osmosis (cells of the medulla have an increased  $\text{Na}^+$  concentration)
- high levels of  $\text{Na}^+$  are the result of active transport
- $\text{Cl}^-$  tend to follow the  $\text{Na}^+$  due to the electrical attraction between the ions.



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## Distal Tubule

- responsible for tubular secretion - active transport to pull substances such as  $\text{H}^+$ , creatinine, and drugs out of the blood and into the filtrate

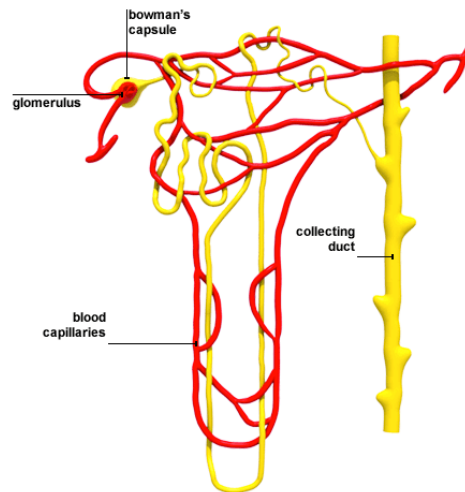


**Urine Formation**

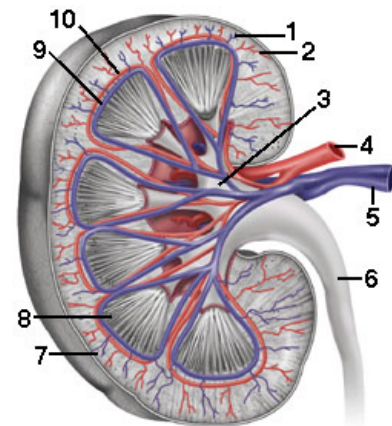
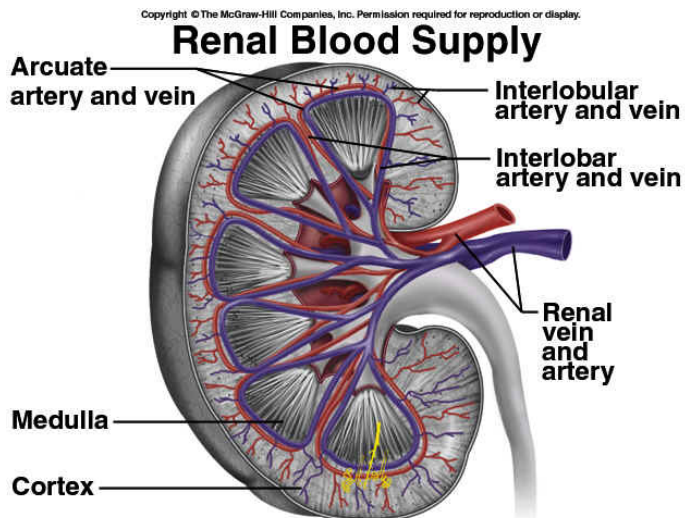
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## Collecting Duct

- carries what can now be called urine into the renal pelvis
- 99% of the water that originally entered the proximal tubule as nephric filtrate has been returned to the body.



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## Urine Output

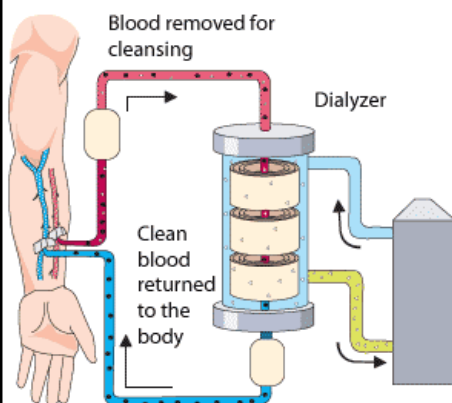
- permeability of the distal tubule and collecting duct is controlled by a hormone called anti-diuretic hormone (ADH)
- ADH is secreted by the pituitary gland to increase permeability when water needs to be conserved.
- inhibiting ADH allows the body to get rid of excess water, increasing urine output.
  - alcohol and caffeine block the release of ADH
- increased urine output is also a symptom of diabetes (due to the presence of too much glucose in the blood)

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## Disorders of the Excretory System

1) Renal Failure - wastes begin to accumulate in the blood

- waste can cause serious damage if they get to high (loss of consciousness + heart failure)

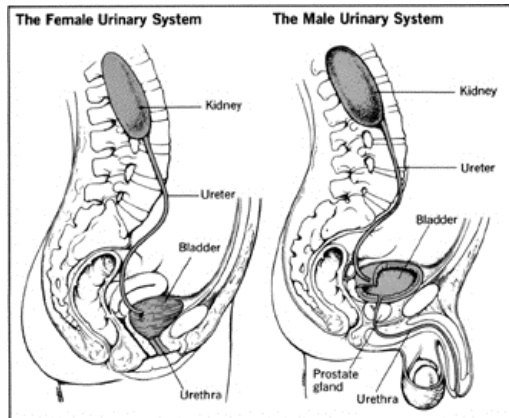


- hemodialysis (kidney dialysis) is a treatment used to clean the blood while waiting for a transplant

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- 2) **Urinary Tract Infection (UTI)** - more common in women than men due to differences in anatomy
- in females the urethral opening and anal opening are closer together making it easier for the bacteria from the bowels to enter and start an infection



- 3) **Kidney Stones** - occur when chemicals in the urine precipitate out and form calcium oxalate crystals
- more common in men
  - frequently caused by reoccurring UTI or insufficient water intake

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